MARCH 1955

AGRICULTURAL Research

SOLUTION

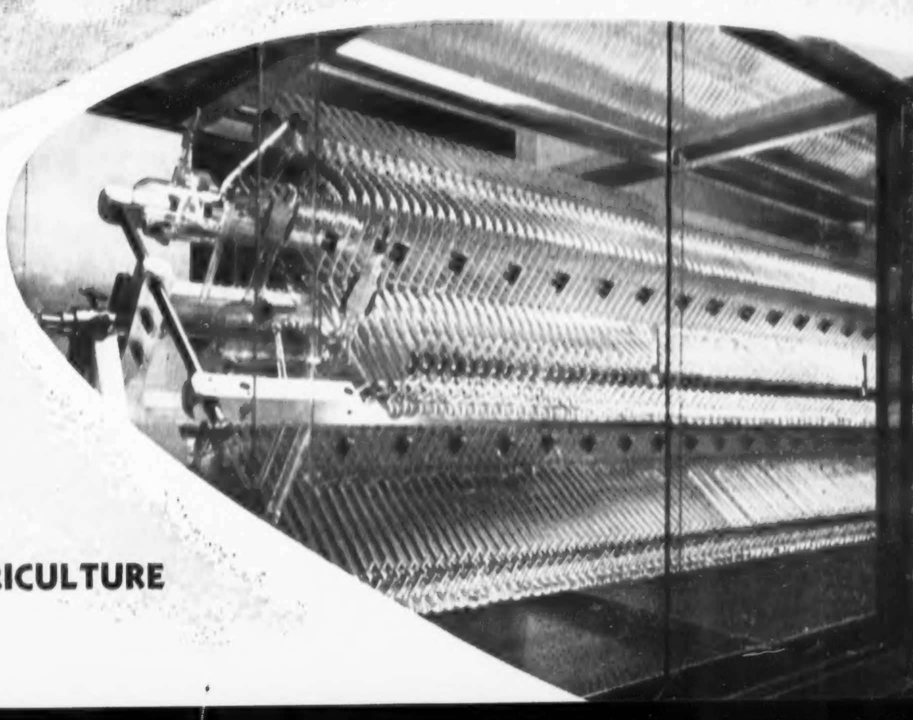
This simple new plant solves a problem of stream pollution from dairy-processing wastes

● see page 4

GAINS

Better hog feed is among the stories of research gains that tell themselves in photographs

● see page 8



PATTERN

A pipe-organ-like instrument reveals the complex structural patterns of our vegetable oils

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UNITED STATES
DEPARTMENT OF AGRICULTURE

AGRICULTURAL Research

Vol. 3—March 1955—No. 9

Joseph F. Silbaugh—Managing Editor

John R. Deatherage—Assistant Editor

CONTENTS

Flow of research

Wheat surplus?

Yes, but the situation was different, once—much different.

In 1898, Sir William Crookes, president of the British Association for the Advancement of Science, created a sensation by predicting that "almost certainly the United States within a generation will be driven to import and will scramble for a lion's share of the world wheat crop."

Crookes was serious. And he knew the facts.

In that day, there was no doctrine of conquering food shortage scientifically. Research in the United States Department of Agriculture and the State agricultural experiment stations was just starting. The vogue in plant improvement was the now-discredited continuous-selection procedure—choice of the plumpest, heaviest kernels from the largest heads of the best plants. We knew little about controlling pests.

Yes, Crookes' 1898 prediction might well have come true.

But our scientists have traveled far since then. They uncovered basic principles of inheritance and devised practical techniques that got quicker, surer results. The concept of developing pest-resistant plants was opened up. To test for resistances, researchers created their own pestilential outbreaks, rather than awaiting Nature's slow pace. We have better culture. That includes fallowing and, for winter wheats, early plowing for more dependable yield. And we have mechanization for better performance with less labor.

So Crookes was wrong. Thanks to research, we're growing nearly twice as much wheat now as then. We're producing far more efficiently. And, as we think of surpluses, we must also recall that science is doing much to help us reap at harvest more nearly what we aim for at seedtime.

Research hasn't run its course. We still have a long way to go to achieve nonwasteful production and non-surplus abundance. Man depends more and more on research, on a continuing flow of agricultural invention.

Research is a wellspring of progress—not a faucet to turn on and off with each turn of a supply curve.

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AGRICULTURAL RESEARCH SERVICE

United States Department of Agriculture

Where can a farmer cut costs?

USING MORE—NOT LESS—OF CASH ITEMS MAY PAY

THE COST-PRICE squeeze in farming is tempting many farmers to cut costs by using less of the cash items that go into production.

USDA studies indicate there are many opportunities to cut costs through *better use* of various production factors—land, machinery, equipment, power, fertilizer, livestock, feeds, labor, and such. But reduced use of cash items will frequently cut income more than outgo.

Cash costs of farming, often identified with modern technology, have gone up about one-fourth in the last 7 years. But ARS economists say that to *increase* out-of-pocket expenditures, rather than to cut them, will often reduce real cost per unit of production. Of course, each expense must be judged in relation to the individual farm situation.

Prices of major production items have risen considerably but in varying amounts since the war. Fertilizer, for example, has gone up about 30 percent, whereas machinery, building materials, and fencing have risen about 80 percent. Labor has increased fourfold. So for reasons of economy as well as changed technology, the best combination of production items today is quite different from that of 10 years ago.

Machinery, motor supplies, fertilizer, spray materials, electricity, and many other nonfarm items have become staples in farming. There are still many attractive opportunities to use more of them in view of their great labor-saving potential and the great rise in farm wage rates.

The changing cost ratios between production items become important in all farm planning that may commit farmers for a number of years. Take for example, plans that call for new machinery to be used and the investment recovered over an extended period, or call for somewhat more or somewhat less hired labor for several years. Such factors will condition farmers' thinking about the possible adoption of new techniques.

The following examples show the complexity of the problem, the variability of opportunity among farms, and a few ways to cut units costs:

On many dairy farms, better techniques in growing and harvesting feed and in using labor—the two biggest cost items—and improved livestock management practices offer the best chances for reducing cost. Growing better and cheaper roughage, in lieu of some purchased concentrates, is an example. Many farmers don't prepare adequate seedbeds for hay and pasture, don't fertilize enough for optimum yield or seed often enough for good plant stand. Many are not using the most efficient haying equipment. Some dairymen feed protein supplements wastefully when cattle are on high-protein pasture. Rearrangement of barns or work patterns, together with use of work-saving devices, can often enable a farm's labor force to handle more cows than at present.

Many wheat farmers in the Plains can cut unit costs by fallowing more land. Higher yield per acre after fallowing, plus some saving in seed and in plowing and harvesting less acreage, will frequently more than offset the cost of fallowing. Some farmers need to increase the acreage they operate as well as the size of their livestock enterprise.

Cotton farmers can often improve net returns by increasing farm size and using more power machinery (especially mechanical pickers and strippers) and cheaper sources of fertilizer (such as anhydrous ammonia). Improvement in the future will depend more and more on such efficiency factors as better land use—possibly some of it to grow feeds that makes less peak-labor demand than cotton. Supplemental enterprises also offer opportunity to increase net returns. (See "Livestock for Released Acres," AGR. RES., Dec. 1954, p. 3.)

Corn Belt studies show that better and cheaper roughage production is possible on many farms. And per-unit costs in raising hogs can be lowered by using practices that save more pigs per litter and by feeding adequate quantities of protein, minerals, and vitamins, especially up to the 100-pound stage. Many farmers could reduce their unit costs by using more commercial fertilizer.

It's true, of course, that some of these cost-reducing methods tend to increase production enough to reduce prices when adopted by large numbers of farmers. Research and education need to be directed to finding which methods best reduce costs without adding extensively to production in periods of oversupply, and to obtaining a balanced production pattern in line with markets.☆

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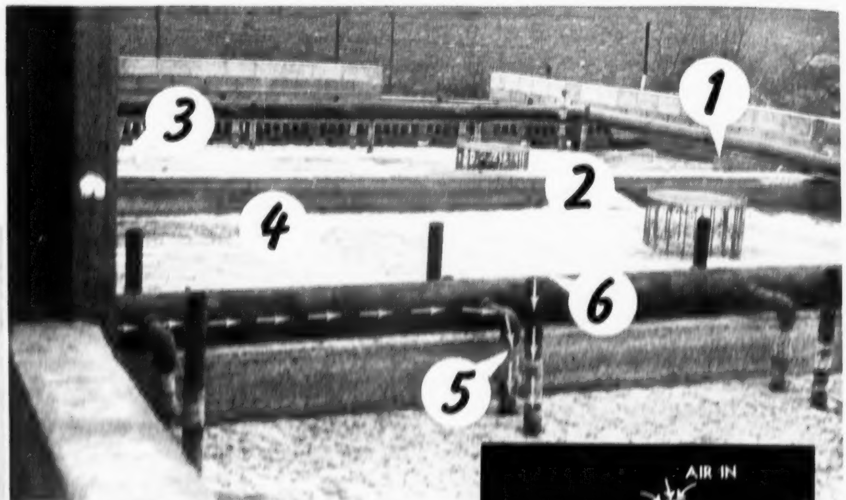
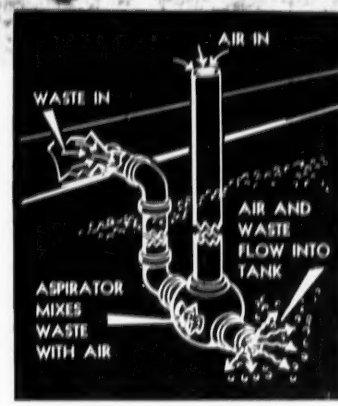
Here's the answer to dairy wastes



MILK WASTE from dairy enters treatment tank (1). Pipes (2) draw in waste, carry it to circulating pump (3). Distributors (4) carry waste to small pipes (5). Other pipes (6) take in air. Waste, mixed with air (right), returns to tank through sludge. Complete circulation requires 6 minutes.



A SIMPLE, ECONOMICAL NEW PLANT THAT WORKS

ONCE-SPARKLING STREAMS now polluted by dairy-processing wastes can again yield fresh water for farmers and fish for sportsmen.

The reason: USDA development, in cooperation with Pennsylvania State University, of a simple and economical dairy-waste disposal system.

Its basis is bio-oxidation—using bacteria to oxidize, or "burn up," the organic wastes. This principle has been applied to waste disposal previously, but the new plant design is the first to be based on an accurate measure of biological activity and the oxygen demand of the wastes.

The system is trouble-free, automatic, and self-cleaning. It eliminates odors, requires no chemicals. And it cuts labor needs by more than 90 percent. The initial cost is less than one-third that of a small, conventional disposal system.

Small losses of milk—especially through the equipment rinse water—are unavoidable in any milk plant. Disposal of this waste has long been one of the dairy industry's most serious problems. Customary sewage treatment is not satisfactory because the polluting strength of milk waste runs about 3 or 4 times as great as that of domestic waste.

Dilute milk wastes—about 1 percent of the total milk processed—usually are discharged into streams. Here, bacteria dispose of the organic materials, mostly proteins and sugars. To do this, the bacteria need plenty of oxygen. Thus, a stream's oxygen supply is soon reduced, aquatic life dies, and putrefactive odors develop. Waterborne epidemics, destruction of fish and wildlife, loss of recreational attractions, and reduced property values are often the result.

Lately, interest in stream pollution has grown. Laws are now strictly enforced—in Pennsylvania alone in a recent year, a hundred actions were filed against dairy plants.

The dairies have generally not been negligent. Engineers have been retained and their recommendations tried, but pollution troubles remained.

ARS scientists S. R. Hoover and N. Porges of the ARS Eastern Regional Research Laboratory, Philadelphia, in cooperation with R. R. Kountz of Pennsylvania State University, tackled this problem and came up with the new disposal system.

Here's how it works: Waste from the dairy flows into a tank containing sludge—a bed of bacterial cells. The waste is then pumped out and returned to the tank through aspirators. These mix air with the waste and bubble it through the sludge to burn up the or-

ganic materials. After aeration for 8 to 16 hours, depending on the amount of waste, the sludge is allowed to settle. The waste—now clear water—is drawn off and discharged into a stream or sewer. The settled sludge remains as a starter for the next day's waste.

Quick, economical treatment takes adequate oxygen as well as a high concentration of bacteria. The bacteria use 1.4 pounds of oxygen in consuming 1 pound of milk solids.

Determining the oxygen demand (polluting strength) of the waste is the first step in setting up the system. This is done by a simple, rapid chemical test. Generally, a plant handling 100,000 pounds of milk daily will need a 35,000-gallon tank, with 2 pumps and 24 aspirators. But one advantage of this system is that it can handle many times its calculated capacity in an emergency.

The initial sludge bed is developed simply by aerating the milk waste itself. Bacteria commonly found in soil, spoiled milk, or air do the work. In a few days the bed builds up to the desired level. It then becomes self-balancing—that is, growth and self-oxidation of the bacteria keep the sludge at this level as long as the flow of waste is uniform. Bacteria numbers may subsequently multiply or decrease, depending on the amount of waste to be handled.

Two full-scale treatment plants based on the University pilot-plant studies have already been built by commercial dairies. Six other units are now under construction.

One dairy using the system had been plagued by disposal problems—involving State actions and one civil suit—for 25 years. Both this plant and the other one now in use have exceeded all expectations in trouble-free operation. In addition, they have enabled the dairies to process several times as much milk.☆

livestock

MAKING BEEF ON MOUNTAIN MEADOWS

Beef-cattle feeding experiments are proving the effectiveness of cooperative USDA, State, and industry research efforts to improve the productivity of mountain meadowlands (Agr. Res., Jan. 1954, p. 4).

In 11 western States, at 6,000 to 9,000 feet above sea level, are 3½ million acres of such land capable of producing bountiful hay and forage crops under proper management.

Feeding tests on these mountain meadows were started at Hayden, Colo., by ARS and the Colorado experiment station. Results show that beef gains can be nearly doubled by the right combination of practices.

These practices, demonstrated by experimental work over a period of about 4 years, are (1) better control of irrigation water, (2) proper timing of harvest, and (3) use of fertilizer—principally nitrogen.

First-year results at Hayden showed that fields treated with 100 pounds of nitrogen early in the spring and another 100 pounds in early July produced 4 tons of hay and 606 pounds of beef per acre. Fertilizer was used along with water control and timing of harvest. Where fertilizer wasn't used, yields were only 2.4 tons of hay and 321 pounds of beef per acre. Use of phosphorus—either alone or with nitrogen—gave little result in hay or beef yields.

At Gunnison, Colo., another beef feeding project is actively supported by a group of Colorado ranchers. Findings here further substantiate the value of this three-phase program of meadowland improvement.

The trials have also proved that beef gains are closely related to the crude protein content of hay.

In two winter feeding tests, using about the same quantity of hay per calf, researchers found that close to 90 percent of the variations in beef gains could be attributed to variations in the protein content of the hay. Calves fed high-protein, early-cut hay gained nearly a pound a day as compared with half a pound for those fed low-protein, late-cut hay. Protein content varied from 1.6 pounds in early-cut hay to only 0.5 pound in the late-cut hay.

Meadowlands research showed higher yields and better hay as the most important results of controlled irrigation. Intermittent sprinkling gave hay yields exceeding 4 tons per acre against 3.2 tons under continuous flooding. Crude protein yields were nearly double the 628 pounds per acre produced by flooding.

Proper harvest timing—an early cut late in June and an aftermath cut in August—gave better quality hay than the traditional late-summer cut. Tonnage ran about the same, but two-cut harvesting boosted protein content to 14 percent as compared with about 9 percent for late-cut hay.

Use of 160 pounds of nitrogen per acre, in combination with controlled irrigation and the two-cut harvest, yielded about $40 worth of crude protein per acre for a fertilizer outlay of about $25 per acre.☆

BLUEBERRIES GROW UP

Promise of new varieties points to big industry

A 1915 VISION is reality now as hybrid Ivanhoe (right) replaces native berry (left).

CONSUMERS and growers alike are enthusiastic about today's tasty, tempting, grape-size blueberries. But USDA scientists plan still bigger and better ones, grown on upright bushes and widely adapted.

The 10,000-acre cultivated-blueberry industry—from Maine to Georgia and in Michigan, Washington, and Oregon—returns \$3½ to \$4 million a year. It's based on varieties originated over the past 35 years from crossings by the late F. V. Coville. The best, brought out in the last 5 years, are Earliblue, Ivanhoe, Bluecrop, Berkeley, Herbert, and Coville for the North, and canker-resistant Angola, Wolcott, Croatan, and Murphy for the South.

Coville's ARS successors—G. M. Darrow, G. H. Scott, Haig Dermen, A. C. Goheen, E. H. Varney and others—look for early replacement of these new varieties. The scientists see even bigger, better berries with small, dry stem scars that won't tear and admit rot. They visualize widespread blueberry culture matching the \$85 million strawberry crop.

To accomplish this, they're trying to recover desirable features from several of our native species. Work has been started to introduce into commercial highbush varieties some features of the native rabbiteye blueberry—vigor, tolerance of a short rest period as well as drought and heat, and other desirable characters. This productive treelike species, *Vaccinium ashei*, grows in the Gulf States and has 6 sets of chromosomes. It has been crossed successfully with each of 3 other species having 2 sets of chromosomes—*V. tenellum*, *V. darrowii*, and *V. elliottii*—to produce tetraploid hybrids with 4 sets of chromosomes, the number in commercial varieties of highbush blueberries.

These crosses are blending the productivity, vigor, flavor, fruit size, disease resistance, and geographic range of the four species with the best qualities of the highbush varieties. This will provide rabbit-eye types with earliness and larger fruit for the South and highbush types with additional vigor and drought resistance for the blueberry areas of the North.

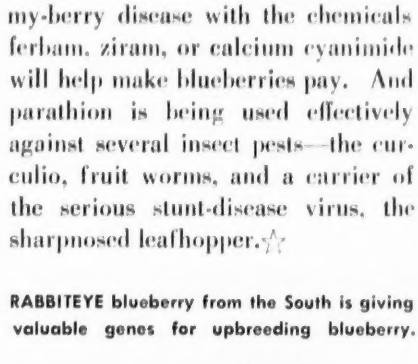
The scientists are surveying other species for characteristics that can be bred into the foregoing lines. One prospect, the Florida evergreen blueberry, *V. myrsinites*, offers extreme heat tolerance, very brief dormancy, and small stem scar. Now that we know how to manipulate chromosome numbers, blueberry breeders also see interesting possibilities in the mountain blueberry, *V. membranaceum*, that grows in the Cascades and Rockies. It offers high flavor, large fruiting, late ripening, and the ability to fruit after 3 or 4 rainless months. Many other species have intriguing possibilities for improving the crop.

In research at experiment stations, New York's J. C. Cain and Oregon's C. A. Boller find that highbush blueberries will thrive on soil only slightly acid if fertilized with ammonium sulfate. This provides ammonia-type nitrogen—the only form the blueberry can use—and makes the soil more acid. That should open great areas of less-acid soil westward to the Mississippi and elsewhere to blueberries. Tests with iron-liberating chelate chemicals in Florida give added encouragement for new areas.

Two weed-control methods—with the chemical CMU, worked out by C. W. Hitz of the Delaware station, and with a power rotary hoe, developed by industry—should lower cost.

Moreover, new controls for mummy-berry disease with the chemicals ferbam, ziram, or calcium cyanimide will help make blueberries pay. And parathion is being used effectively against several insect pests—the curculio, fruit worms, and a carrier of the serious stunt-disease virus, the sharpnosed leafhopper.☆

RABBITEYE blueberry from the South is giving valuable genes for upbreeding blueberry.



Lessons from 'Hazel'

STORM SPURS USE OF FARM-BUILDING RESEARCH FINDINGS

LAST OCTOBER'S "Hurricane Hazel" was an ill wind and no lady. She went out of her way to impress the East with the importance of findings from several years of farm-building-construction research.

Other areas frequented by high winds and hurricanes would do well to study these same lessons.

In Maryland alone, Hazel took a toll of more than 2,000 poultry houses, 700 tobacco barns, and small farm-service buildings too numerous to mention. The extent of damage and reasons for the failure of many farm buildings to stand before the storm were studied by USDA and University of Maryland engineers, cooperating with Maryland county authorities, in a survey recently completed. Reconstruction, already underway, is being aided in Maryland and other States by the researchers' findings.

This survey traced building failures to faulty construction in the great majority of cases. Wind pressures during the storm *were* exceptionally heavy. But well-constructed buildings suffered relatively minor damage, despite isolation and lack of protection from the elements.

Properly constructed gable and pole-type buildings seemed to stand up well against Hazel. Long buildings that had few interior partitions—for example, poultry houses with shed-type or flat roofs—suffered the greatest damage. Noteworthy was the lack of damage to dwellings. Normally of better basic construction, such buildings had the added advantage of many interior partitions that strengthened the entire framework.

Engineers blamed failures on: (1) poor footings and foundations; (2) insufficient anchorage of walls to foundations; (3) inadequate bracing; and (4) poor joint construction at the junctions of sills and studs, lintels, rafters, and girders.

Survey findings are the basis of a "fact sheet" issued by the University of Maryland Extension Service in cooperation with ARS and Maryland county governments. Findings will also be incorporated in a USDA bulletin being prepared.

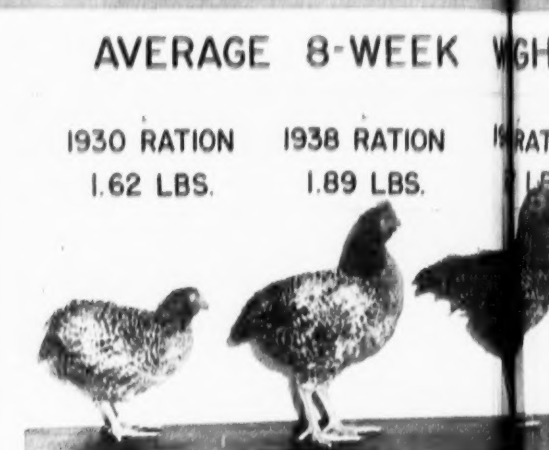
This sheet pinpoints reasons for failure of farm-service buildings during Hazel. Drawings and instructions are provided for erecting this type building in hurricane or tornado-frequented areas. Construction details resulted from analysis of designs by ARS engineers. Included are nailed joints and other connections developed cooperatively with U. S. Forest Products Laboratory, Madison, Wis., as well as design information from other sources.

Methods detailed in the fact sheet emphasize proper footings and foundations; adequate anchorage of walls to foundations; proper nailing, bracing, and joint construction; and use of commercially available steel straps and anchors for stronger joint construction and framing.☆

HOW TIMES HAVE CHANGED

We have come a long way since Secretary of Agriculture James Wilson lauded our grandfathers, 50 years ago, for output "so large as to be beyond any rational comprehension." Farm output now is ly tw days. Federa te, a played a big . H stories that pi s can

SWINE: Littermate Poland China barrows from a Minnesota station trial show new research has more than doubled efficiency of pig rations. Different breeds were put into 3 feeding groups with average starting weights just over 51 pounds. Those fed 1953 ration gained 2½ times faster than those on 1910 ration, ate only half as much feed for each 100 pounds of gain. Average weights: pigs on 1953 ration, 200 lbs.; on 1930 ration, 103 lbs.; on 1910 ration, 105 lbs.



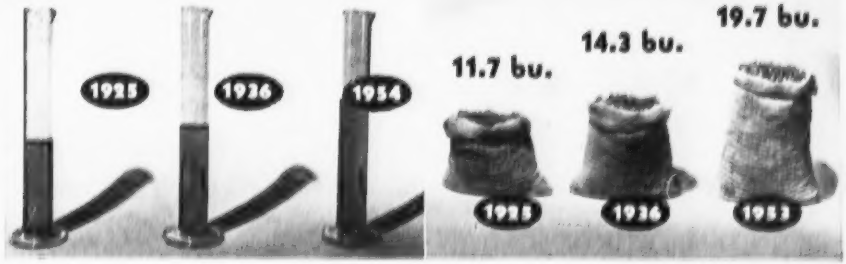
POULTRY: Modern poultry rations developed through nu esear industry. A recent experiment conducted at the Maryland show been: Matched Barred Rock-New Hampshire cross broilers vided end of 8 weeks, male birds fed 1954 rations had gained 7 t fast fed on 1930 rations. Almost 54 percent of the improve me i cating that the recent research developments can bring ater

GRAIN SORGHUMS: Today, farmers can produce grain sorghums with about one-fourth as much work as 40 years ago. Research by USDA plant breeders helped to make this possible. Scientists took the old 7-foot, top-heavy sorghums, which had to be harvested by hand, and reduced them by the 1940's to 3-foot, straight-headed sorghums that could be harvested with combines. This achievement has resulted in saving 75 hours of work in producing 100 bushels of sorghum grain.

BEEF CATTLE: Research progress in developing fast-gain of for cattle raisers to put 2½ pounds a day on growing en gains of only 2 pounds a day. The yearling steers s ill on at the U. S. Range Livestock Experiment Station, Mi Mon sents the average weight of 904 pounds that was recor 43. the average weight of 1,064 pounds achieved in 1953 ng

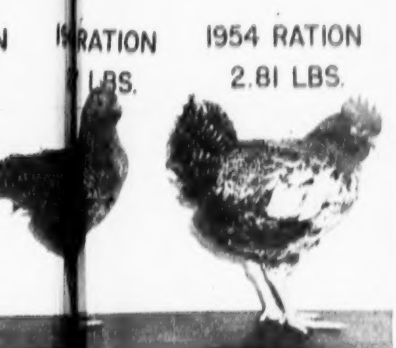
A look at some
:search achievements
over 50 years

ow is ly twice what it was in those
Federa te, and private research has
a big . Here are a few of the
hat pi can tell of these advances.

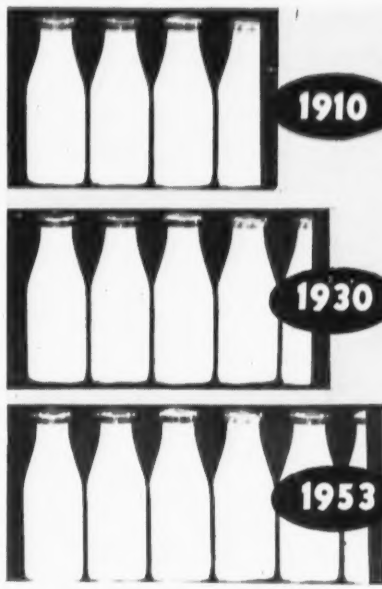


SOYBEANS: Once a limited forage crop in the Southeast, the soybean is now grown in 31 States. It has become our top-ranking vegetable-oil crop—largely as a result of cooperative USDA-State research. Acre yields and oil content have risen—the latter by more than 2 pounds per bushel since 1925. All of our important soybean varieties have come through introduction, selection, and hybridization under this research program. The Bankhead-Jones Regional Soybean Laboratory at Urbana, Ill., serves as a focal point for cooperative agronomic research for the soybean. Utilization research is centered at the Northern Regional Research Laboratory, Peoria, Ill. (see story in this issue, p. 11).

K WGHTS, MALES



ugh nu search have revolutionized the broiler
aryland shows how great this improvement has
broilers vided into 4 pens (see photo). At the
ained 7 t faster or 1.19 pounds more than those
improve me in the last 8 years, however, indi-
bring ater improvement if followed through.



MILK: Today's average dairy cow in the United States is producing 45 percent more milk than her predecessor did about 40 years ago. The country's annual average production per cow has increased from 3,750 pounds of milk in 1910 to 4,508 pounds in 1930 and 5,447 pounds in 1953. The increase has been even greater where improved dairying practices have been consistently and steadily applied, as in Dairy Herd Improvement Association herds and in official tests of various dairy breed associations throughout the Nation. The million Dairy Herd Improvement Association cows have increased their annual milk production from 5,730 pounds in 1910 to 7,642 pounds in 1930 to 9,253 pounds in 1953. Dairying practices responsible for this gain are the result of long-time research that has been carried on cooperatively by the U. S. Department of Agriculture, State experiment stations, and progressive dairy farmers. These practices include use of proved sires, artificial breeding, disease and insect control, and better feeding based on wider knowledge of nutrition we now have.

st-gain of beef cattle now makes it possible
owing en years ago, producers were getting
eers sh illustrate the results of tests carried
on, Mi Mont. The animal on the left repre-
s recor 43. The steer on the right represents
n 1953 g period in both cases is the same.

TOBACCO: Researchers have found an answer to black shank, the fungus rot that often wipes out an entire crop of susceptible tobacco. Note the damage black shank did to a 1940-type burley (middle row) and how new varieties (on either side) can produce big, healthy plants in the same field. Cumulative successes by USDA-State plant breeders in developing varieties of burley tobacco resistant to black root rot mean growers today get an average increase of 400 pounds or more in per-acre yields. With the newest varieties they can also get more high-quality cigarette tobacco. Farmers may expect other developments in tobacco through continued cooperative research.

food
and home

Halting enzymes in frozen foods

CAREFUL HEAT TREATMENT SAVES THAT GARDEN-FRESH QUALITY

NEW INFORMATION on how to control enzymes in frozen fruits and vegetables so these foods will hold their garden-fresh quality is reported by USDA scientists.

They found that frozen peas have superior flavor and keeping quality when given a prefreezing heat treatment that completely inactivates the enzyme *catalase*—and continues just long enough to halt the activity of a second enzyme, *peroxidase*.

W. C. Dietrich, F. E. Lindquist, and coworkers at the ARS Western Regional Research Laboratory, Albany, Calif., conducted these tests. Samples of peas were packed and frozen after blanching (scalding) treatments designed to give different degrees of enzyme inactivation. Groups of samples were then stored for 1 year at 3 different temperatures—10°, 0°, and −10° F. After storage, the peas were analyzed for ascorbic-acid content and degradation of chlorophyll. They also underwent taste-panel tests of eating quality, based on color, flavor, and skin texture.

When temperature and blanching time were adequate to stop catalase action in the peas—but not sufficient to inactivate more than half the peroxidase present—the flavor of the frozen product deteriorated in storage. This occurred even though the peas retained most of their vitamin C (ascorbic acid) and original green color (chlorophyll).

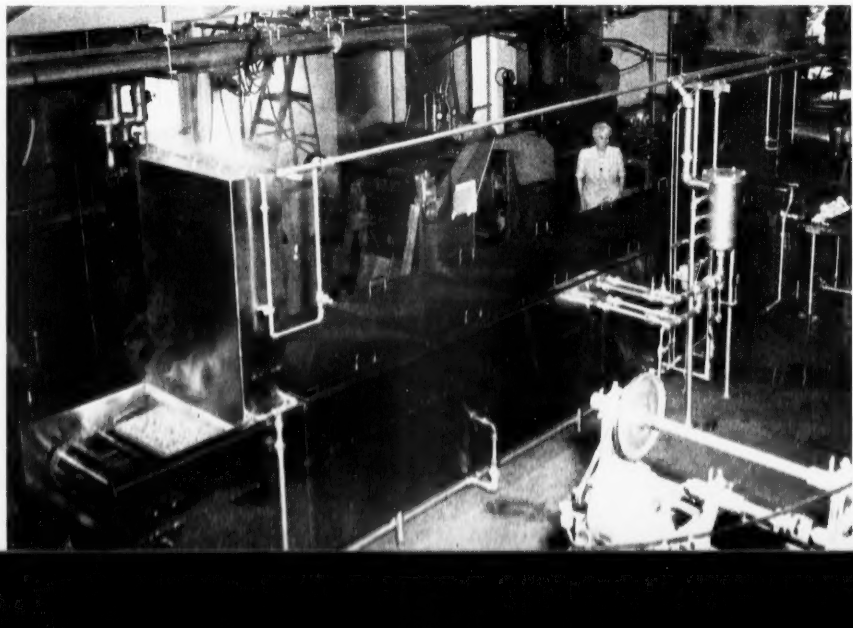
Similar results were obtained by the Western laboratory in tests of apricot purees. J. D. Ponting and coworkers found that heating purees just enough to inactivate the enzyme *polyphenoloxidase* gives a better product, with more natural flavor and color, than purees subjected to greater or less heat. Even slight underheating (95-percent inactivation of the enzyme) led to browning and development of off-flavors. Overheating tended to give the puree a cooked, sometimes bitter flavor.

The optimum quick, high-temperature heat treatment (194° F. for 10 seconds) gave a product of about the same quality as longer heating at a lower temperature (187° F. for 60 seconds). Both these treatments were just adequate to stop polyphenoloxidase activity in the puree.

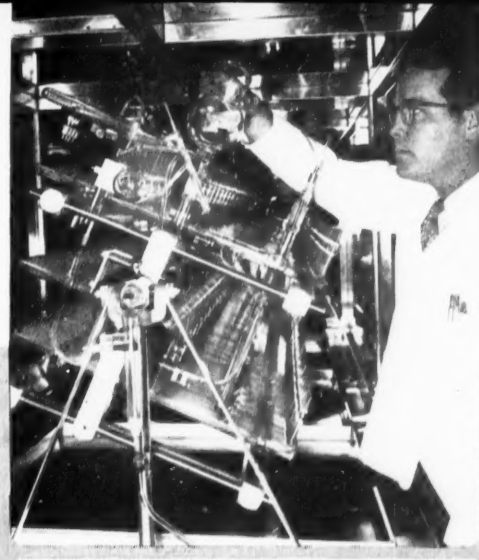
The enzymes directly responsible for chemical changes that cause off-flavors and color changes in fruits and vegetables have never been completely identified. For many years, however, frozen-food packers have tried to measure catalase and peroxidase activity in their products to check the effectiveness of heating and blanching treatments. There has been industry-wide interest in improving enzyme tests—particularly for peroxidase—and in learning how to use them to produce frozen food that will keep better in storage.

Some years ago, Western laboratory scientists developed two such enzyme tests: (1) a method that's suitable for research use to measure the exact amount of peroxidase activity in vegetable tissues; and (2) a method that enables food processors to make rapid estimates of peroxidase activity in vegetables passing at many tons per hour through steam or hot-water heating equipment.

These tests, together with advancing knowledge of the enzymes themselves, are helping to give consumers better frozen-food products.☆



STEAM BLANCHER at Western Regional Research Laboratory, Albany, Calif., is used in food-processing experiments, including enzyme-inactivation studies discussed in this story.



SOLVENT IS ADDED to 200-tube Craig-Post counter-current-distribution apparatus, now giving us a new look at vegetable-oil structure. Automatic in operation, it's super-efficient. Oil sample is subjected in each tube to simultaneous action of two solvents that don't mix together. Machine rocks back and forth, stops periodically to allow settling, then transfers part of one oil-solvent mixture to next tube, where the same process is repeated. Finally, many oil fractions are distributed in the tubes—giving a stretched-out view of vegetable oil's structural pattern.

VOLUNTEER TASTE-TESTERS help chemists evaluate new methods of improving flavor stability of soybean oil. Tasting is done in special room, where light, temperature, and humidity are carefully controlled to help make consistent judgments. Pioneer taste-panel work under Helen A. Moser at Northern Regional Research Laboratory has led to wider use of taste panels by the food industry, shown oil processors the value of metal deactivators, resulted in other improvements in oil production.

Toward more useful

VEGETABLE OILS

CHEMICAL KNOW-HOW MAY HELP TAILOR OILS TO OUR NEEDS

WITH A COMPLEX "pipe organ" of glass and stainless steel, USDA researchers are playing a new tune of scientific discovery in studies of vegetable oils.

This strange instrument (see photo) is known as a 200-tube, automatic Craig-Post countercurrent-distribution apparatus. It's a powerful new research tool for analyzing the structure of seed oils and other materials. It can make analyses faster and with greater precision and thoroughness than instruments previously available.

Under the leadership of ARS chemist J. C. Cowan of the Northern Regional Research Laboratory, Peoria, Ill., this oilseed research is aimed at getting basic information that can help improve vegetable oils for industrial and food uses. The eventual goal—hoped for, though not yet completely in sight—is advanced chemical know-how that will permit oil processors to tailor-make various fats and oils into more useful products. At present, the way Nature constructs a vegetable oil largely determines its uses. Linseed oil, for instance, contains a lot of linolenic acid, which helps make it an excellent drying oil for paints and varnishes. Its drying properties are based on the ability of linolenic acid to combine with oxygen. But this same fatty acid tends to make linseed oil unsuitable for food.

Soybean oil, which contains a relatively smaller amount of linolenic acid, goes into many industrial products and also into shortening, margarine, and other foods. But it has a greater tendency than some vegetable oils to develop undesirable flavors in foods. Peoria researchers established some years ago that the linolenic acid is a major cause of this flavor reversion.

Why not merely eliminate the linolenic acid from soybean oil intended for food use? For a long time, the chemists thought this might be practical. The theory was that linolenic acid occurred in a more or less segregated

part of the oil and might be got rid of by some commercially feasible fractionation process. But recent studies at the Peoria laboratory, using a small, old-type Craig-Post machine, tell a different story on soybean-oil structure. It turns out, disappointingly, that linolenic acid is chemically dispersed *throughout the oil* and cannot be removed by ordinary fractionation techniques.

To the chemists, however, this merely calls for a different approach to flavor reversion. Their new knowledge of the oil's chemical makeup—which they hope to extend still further with the new Craig-Post apparatus—gives them a better chance to find the *right* approach.

One possibility is that soybean oil might be *reconstructed* chemically to segregate linolenic acid and make it easier to remove. A desired result would be production of two new derivatives—one good for paint and varnish, the other with superior qualities for foods.

The 200-tube Craig-Post instrument, in operation at Peoria during the past year, has already suggested a new chemical concept for linseed oil. Chemists H. J. Dutton and J. A. Cannon found with the machine that one sample of linseed oil contained two basic components (glycerides) not supposed to be present, according to generally accepted theory. These substances—trilinolenin and dilinoleolinolenin—actually constitute about 22 percent of this linseed oil. Dutton and Cannon's analysis also reveals that two other glycerides are distributed in the oil in a way not previously accounted for.

Similar analyses of soybean oil have likewise indicated a need to redraw the theoretical picture of this oil's structure. These fundamental findings represent important steps forward in our understanding of vegetable oils—and should make possible corresponding advances in the improvement of these oils for particular uses.

The diversity of products made from soybean oil—and particularly today's improved oil for foods—is a result in part of research at the Peoria laboratory. Its scientists and engineers have played a prominent role in:

1. Introducing to our soybean-oil industry the use of metal deactivators (chiefly citric acid) to produce an edible oil with much greater flavor stability.

2. Showing oil processors the importance of avoiding contamination by traces of iron, copper, or other metals.

3. Developing objective taste-panel methods for evaluating oil quality (see photo, p. 11).

4. Demonstrating the value of improved equipment and methods for deodorizing soybean oil (this is the final processing step, in which the last remaining volatile flavor constituents of the oil are removed).

Various phases of this vegetable-oil work are continuing. Included are development of better metal deactivators, elimination of linolenic acid, and determination of the molecular structure of soybean phosphatides. ☆

Report on WEEDK

Some interesting new prospects found in last season's field tests of some 70 herbicidal chemicals

FOR EVERY NEW farm chemical that appears on the market, scientists must check the properties of thousands of compounds.

Weed investigators keep busy the year round in their evaluation research on new herbicidal chemicals at USDA's Agricultural Research Center, Beltsville, Md. (AGR. RES., October 1953, p. 8).

In 1954, these researchers field-tested 70 chemicals as pre- and post-emergence sprays. All were organic compounds, in such divergent groups as:

PHENOXY COMPOUNDS—the well-known broad-leaved weed killers 2,4–D, 3,4–D, MCP, and 2,4–5–T, as well as a series of salts and heavy-molecular-weight low-volatile esters of phenoxy*acetic*-acid derivatives. The same series of derivatives of phenoxy*propionic* acids have been evaluated as herbicides. Still another group of phenoxy compounds—gamma phenoxy*butyric* acids—have shown high herbicidal activity and selectivity.

SUBSTITUTED UREA COMPOUNDS—materials such as CMU and PDU that were first introduced as soil-sterilant chemicals but are now being tested for their selective herbicidal properties.

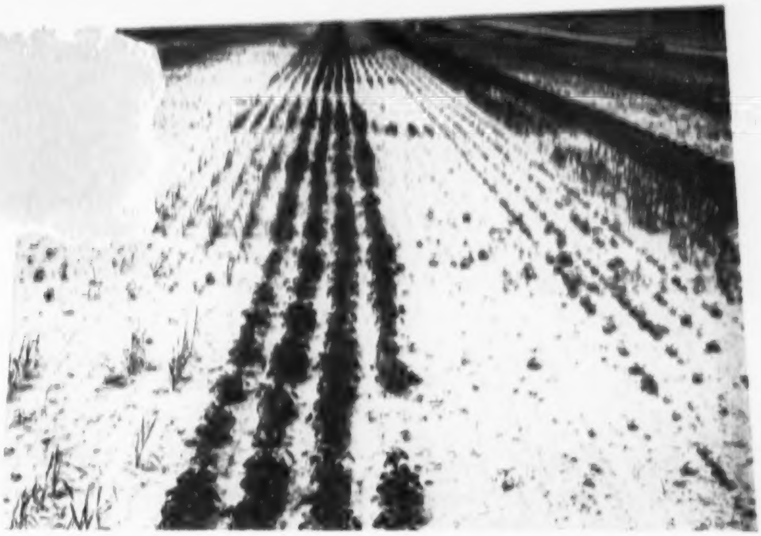
CARBAMATE COMPOUNDS—several new ones with high herbicidal activity, selectivity, and low volatility, that show promise for pre-emergence use.

A notable compound studied in the 1954 trials was 3-amino-1,2,4-triazole (see photo 6).

Also tested was 2,3,6-trichlorobenzoic acid (see photo 7), which provided weed control for 60 days when applied as a pre-emergence treatment.

Two other materials, 2,2-dichloropropionate and gamma, beta, trichloropropionate were effective as *post*-emergency sprays in control of grasses and as *pre*-emergence sprays in control of weeds in sugar beets and several other crops. ☆

DKILLERS



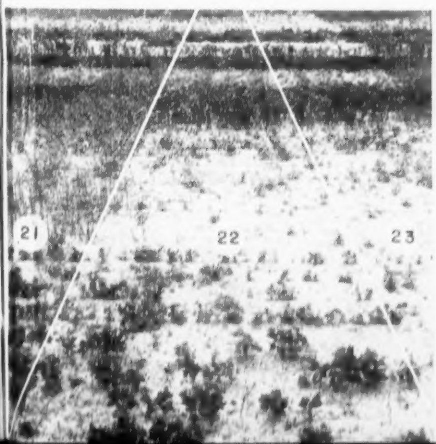
1. Seventy herbicides were applied as pre- and post-emergence sprays in swaths across these crop rows. Each swath is a numbered plot. Photo looks down four rows of squash. To right are buckwheat, peanuts, corn, soybeans, alfalfa, cotton, snap beans, sorghum, sugar beets, Ladino clover, flax, cucumbers, lima beans. To left are Sudan grass, lespedeza, wheat, cantaloup, oats, field peas, kenaf. Seeded throughout are five representative varieties of weeds: ryegrass, crab grass, mustard, pigweed, millet. (Note carbamates' damage to buckwheat, right of squash.)

2. Pre-emergence sprays of low-volatile ester forms of 2,4-D (left) and 2,4,5-T (right) attack seedlings and roots of grassy weeds and plants. The 2,4-D ester killed practically all weeds—only lima beans and sorghum of identifiable crops weren't killed. The 2,4,5-T ester was milder, allowed good survival of several crops, some weeds. *Post-emergence* sprays damaged broadleaved plants, left grasses relatively unharmed.

3. Corn, sorghum, lima beans, snap beans, and soybeans were freed from weeds and uninjured by a pre-emergence application of 1 pound per acre of a low volatile ester of 2,4,5-trichlorophenoxypropionic acid. It was used at 1, 2, and 4 pounds per acre from left to right across the plot. It destroyed most weeds, such crops as cucumbers, flax, Ladino clover, sugar beets, and cotton. Corn and sorghum were most tolerant.

4. Substituted-urea compound PDU—that's 3-(phenyl)-1,1-dimethylurea—applied as pre-emergence treatment on sorghum resulted in weed-free plot (left). At right, where the weeds weren't controlled, notice the injury and reduced growth of sorghum due to intense competition from heavy stand of weeds. This compound is receiving some commercial use as a soil sterilant, as well as undergoing tests as a selective herbicide.

5. Carbamate compounds show great promise as pre-emergence herbicides for broad-leaved crops. Plots were pre-emergence treated with 2-(1-chloropropyl) N-(3-chlorophenyl) carbamate (Plot 22) and isopropyl N-(3-methylphenyl) carbamate (Plot 23). Note untreated check (Plot 21). These compounds are relatively low-volatile, highly selective. Here, they weeded sugar beets, snap beans, squash, limas, sorghum, soybeans.



6. These sugar beets (Plot 31) were left weed free as a result of pre-emergence treatment with 3-amino-1,2,4-triazole at the rate of 8 and 16 pounds per acre. Plot in background received no herbicide. This compound effectively controlled both the grassy and broad-leaved weeds in lima beans, sugar beets, sorghum, and corn. Normally, green foliage of affected plants becomes white, indicating inhibition of chlorophyll.

7. A benzoic acid compound—the sodium salt of 2,3,6-trichlorobenzoic acid—applied pre-emergence on Plot 40 was good only for corn. This experimental material killed all other crops and weeds, except some sorghum. Researchers speculate that the difference between skimpy sorghum and good-looking corn may have been due to seed depth. Regulating planting depth may help make compound ideal for corn, sorghum.

CONSIDERING *The Lilies*

RESEARCH AND BREEDING PRODUCE STRIKING NEW PLANTS FOR MANY USES

EASTER LILIES are on the verge of becoming all-season flowers. About 40 new hybrids, better than standard varieties, are being evaluated by USDA researchers during the Easter blooming season. The public will get some in 2 to 4 years.

The Easter pot-flower trade, principal outlet for Easter lilies today, will find that some of these hybrids not only have bigger, finer blossoms, but also flower on short stems 14 to 18 inches long. That's a better height for potted plants than you'll find in standard varieties. On the other hand, churchgoers and hotel patrons will enjoy fine vase lilies on stems 3 to 3½ feet long, a desirable length for this use. And those who want better lilies for floral pieces, chiefly funeral sprays, will find some prolific plants in this collection. The number of flowers—not stem length—is important here.

A chosen few of the new varieties will be increased for public release. That takes years, of course, since increasing one bulb to hundreds of thousands is a slow process.

S. L. Emsweller, N. W. Stuart, and associates bred the new lilies at the ARS Plant Industry Station, Beltsville, Md. Working cooperatively over the years were scientists of State agencies—notably the Louisiana, Oregon, and West Virginia experiment stations—and members of the Society of American Florists and Ornamental Horticulturists.

Breeding these plants took basic work with lily chromosomes, inheritance vehicles found in the cells. Easter lily chromosomes come in sets of 12. The standard varieties are *diploids*—that is, each cell has *2* sets of chromosomes, or a total of 24. Some years ago the scientists treated these diploids with the drug colchicine (AGR. RES., October 1953, p. 3) and got *tetraploids* with *4* sets of chromosomes, or a total of 48.

The tetraploids bear bigger, better-textured flowers but fewer per plant. The blossoms are pleasing, but the public wants freer blooming and variation of stem length. Crossing was tried to accomplish this.

Crossing the tetraploids proved difficult, however, owing to sterility problems common among tetraploids of many species. Nonpairing of chromosomes, or their pairing in 3's, and other chromosome derangements seem to be the cause. These plant breeders also found that the ovules in lily tetraploids appear to be short lived—to degenerate before the pollen has time to grow down to them.

The scientists overcame these difficulties by treating parent plants with various growth regulators—2,4,5-trichlorophenoxyacetic acid, indolebutyric acid, indoleacetic acid, naphthaleneacetic acid, and naphthaleneacetamide. The last proved best. An 0.1 to 1.0 percent solution applied to petal-tear wounds caused rapid movement of sugars to the developing pods. It may have helped produce seed pods—may have sustained life awhile in the embryo sac.

Thus, many intercrosses have been made among the best of the tetraploid varieties. Resultant seedlings—the promising ones now being evaluated—are large-flowered and free-blooming. They grow to various stem lengths, as wanted. Thousands of additional seedlings from later crossings are also coming along and will be evaluated in the future.☆

DOUBLING CHROMOSOMES *of the smaller variety, using the chemical colchicine, made the tetraploid that bears larger but fewer flowers. Intercrossing among tetraploids restored free-flowering and contributed many other worthwhile features including varied stem lengths.*

SODA STRAW *slipped over the flower's pistil aids crossing—permits hand pollination but keeps off the plant's own pollen.*

poultry

MORE LIGHT-PLUMAGED MEAT-TYPE POULTRY

LIGHT-PLUMAGED TURKEYS AND BROILERS may some day predominate among the meat-type birds produced for market in the United States.

Already highly favored by growers, processors and consumers, such breeds are coming into constantly increasing use. And, in some instances at least, these birds are bringing growers better prices.

This swing toward light-plumage is being aided by USDA scientists at the Agricultural Research Center, Beltsville, Md. In recent years, they have developed two important new breeds—the Beltsville Small White turkey, and the Silver Cornish chicken (AGR. RES., February 1955, p. 8). Both are helping fill the demand for light-colored breeding stock.

Commercial breeders have also responded. Increasing numbers of white-plumaged, broad-breasted turkeys are available today in all desired weights. Similarly, for broiler raisers, there are improved meat-type strains of White Rocks, White Americans, Rock-Cornish crosses, the new Silver Cornish, and others that produce light-plumaged market birds.

Such birds—either turkeys or broilers—find general approval. Growers like them because they market readily, processors because they are easier to dress, consumers because they look clean and appetizing.

It was "consumer appeal," combining clean appearance and "family-size" birds, that made the Beltsville Small White turkey popular within a few years after its development. Last year, the number of this breed raised for market approached 30 percent of our entire production.

As the Beltsville Small White gained popularity, it helped stimulate demand for white-plumaged turkeys of heavier weights. These are now becoming popular. For the first 9 years the National Turkey Improvement Plan was operated, medium to large White Holland breeding turkeys comprised only about 4 percent of the breeding birds in this nationwide program. In 1954, heavy white breeds comprised 8.6 percent of the total. ARS poultry husbandman Stanley Marsden predicts that such turkeys may comprise as much as 20 percent of the total number of blood-tested flocks participating in the plan in 1955 if this trend continues. Thus, there will be more heavy, white birds for growers.

The swing to light-plumaged birds is perhaps less marked in broilers than in turkeys. As foundation stock becomes more readily available, however, the trend is expected to pick up. C. W. Knox, poultry breeding research head at Beltsville, sees the new Silver Cornish as one means to this end. Crossing male birds of this breed with New Hampshire females produces a bird with light plumage similar to that of the male parents. This makes it possible for commercial breeders to meet the demand for light-plumaged birds without a major upset of their breeding programs, in which the New Hampshire frequently predominates.☆

Readers' REACTIONS

Tight inspection

SIR: The article "A Test for Anaplasmosis" [AGR. RES., December 1954, p. 5] states that "Meat of cattle infected with anaplasmosis is safe human food." This conclusion is not in accordance with recognized meat-hygiene principles, and we have received information from the field indicating that the statement has been misinterpreted.

Carcasses of cattle that are found on post mortem inspection to be infected with anaplasmosis are condemned by Federal meat inspectors since this meat is not considered wholesome human food.

Animals may be classed as recovered cases of anaplasmosis when there is no evidence of abnormal symptoms on antemortem inspection and the post mortem inspection does not reveal conditions that would make the meat unwholesome. The carcasses of such cattle are passed for food.—R. K. SOMERS, Chief, Inspection Procedures Section, Meat Inspection Branch, ARS, Washington, D. C.

● Thanks for clarifying this point.—ED.

Loose connection

SIR: I note by the current number of AGRICULTURAL RESEARCH ["New Farm Power Prospect," December 1954, p. 15] that electric weed control now has the blessing of the U. S. Department of Agriculture!—C. J. WILLARD, Professor of Agronomy, Ohio State University, Columbus.

● There is, of course, a lack of fundamental information on the effects of electricity on weeds.

AGRICULTURAL RESEARCH was merely reporting the fact that USDA researchers plan to test the potentiality of an electricity-generating tractor as a means of weed, insect, and nematode control.

We regret that the article conveyed to anyone the impression that all problems connected with the use of electric current for these purposes have been solved and that USDA endorses the practices. No blessings intended!—ED.

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agrisearch notes

LADINO CLOVER has shown up well as a perennial or reseeding pasture legume in Missouri grass sods.

Agronomists O. H. Fletchall and E. M. Brown of the Missouri experiment station, in cooperation with USDA, found that spring seedings of Ladino clover on disked or untilled sods gave best stands in grass. On prepared seedbeds, late-summer seedings did best.

Disking, to kill about half the grass sod, was 85 percent as effective as complete seedbed preparation. Under favorable conditions, seeding without tillage developed a good stand—saved expensive renovation, loss of pasture use.

It's hard to get clover stands in thick, heavy sods. But thin sods allow seedlings to become established, with proper care, moisture, and fertility.

THE EUROPEAN CHAFER, an insect about as destructive as the Japanese beetle, is spreading its range and threatening our grasslands.

ARS and State entomologists found this beetle last summer for the first time at Capon Bridge, W. Va., and at Elmira, Geneva, Liverpool, Niagara Falls, and Syracuse, N. Y.

Possible quarantining of Connecticut, New York, and West Virginia was to be considered at a public hearing at Pittsburgh, Pa., March 10.

The chafer lives in the soil and feeds on plant roots, principally grasses, in its grub stage. It cuts main roots near the soil surface, causing the plants to die. Ordinarily the injured turf in chafer-infested areas can be lifted easily from the ground in blocks.

Prior to last summer, entomologists thought this insect occurred only in limited areas of the Northeast—in Wayne County, N. Y. (where it was first found on American soil in 1940), in Monroe, Ontario, Seneca, and Onondaga Counties, N. Y., and in New Haven County, Conn. Up to 1954, its known range was limited to a total of about 700 square miles, mostly in New York State but also locally in Connecticut.

ARS entomologists believe the new infestations started with 1946 shipments of balled nursery stock from Newark, Wayne County, N. Y.

ARS and New York researchers have curbed chafer migration under orders requiring insecticidal treatment of nursery stock originating there. Nurserymen also cooperate to curb spread of the insect.

ARS and New York researchers are working on methods of controlling this pest. Last year they treated 250 acres of nurseries with DDT.

A BAIT SPRAY developed by ARS entomologists protects several Hawaiian fruits from oriental fruit flies and melon flies. The spray is made up of water, malathion insecticide, and a hydrolyzed yeast protein that attracts the insects.

Entomologist L. F. Steiner, who directed this development, reports that a good distribution of bait spray on foliage throughout the orchard brings flies to their doom. Baits are effective at least a week—in dry weather, 3 or more weeks.

Thus far, entomologists recommend the bait spray for use only on mango, passion fruit, and guava trees. Tests are underway to determine the toxic effect of malathion on other tropical and subtropical crops attacked by fruit flies.

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